

What is claimed is:

1. An inductive coupler for a wired pipe joint, comprising:

- a first flux-loop inductive coupler element including a ring-like first core having high magnetic permeability, said first core defining a first axis, a first exterior substantially cylindrical face, and a first interior conical-section annular face, the first interior face defining a first larger-diameter face, a first smaller-diameter face, and an annular first groove, the first groove located between the first larger-diameter face and the first smaller-diameter face, and a first electrically conductive coil wound within said first groove; and
- a second flux-loop inductive coupler element including a ring-like second core having high magnetic permeability, said second core defining a second axis, a second interior substantially cylindrical face and a second exterior conical-section annular face, the second exterior face defining a second smaller-diameter face, a second larger-diameter face, and an annular second groove, the second groove located between the second smaller-diameter face and the second larger-diameter face, and a second electrically conductive coil wound within said second groove;

wherein said first and second elements are adapted to mate with first larger-diameter face facing second larger-diameter face, and first smaller-diameter face facing second smaller-diameter face;

whereby said first and second cores form a low-reluctance closed ring-like magnetic path around said first and second coils.

- 2. An inductive coupler according to claim 1, wherein the first interior conical-section annular face defines a conical shape with an apex on the first axis, and the second exterior conical-section annular face defines a conical shape with an apex on the second axis.
- 3. An inductive coupler according to claim 1, wherein each core defines a conduit for passage of at least one electrical cable coupled to its coil.
- 4. A first flux-loop inductive coupler element for electrical coupling with a second flux-loop inductive coupler element, said first flux-loop inductive coupler element comprising:

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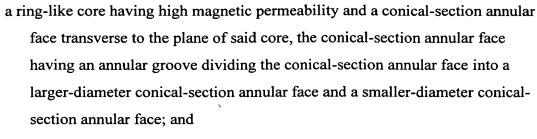
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a coil wound within the annular groove.

- 5. An inductive coupler element according to claim 4, further comprising a tubular support member adapted to mount said inductive coupler element within the bore of a wired pipe joint.
- An inductive coupler element according to claim 4, wherein said core
 defines a conduit for passage of at least one electrical cable coupled to said
 coil.
 - 7. An inductive coupler element according to claim 4, wherein said coil does not substantially protrude forward of the conical face.
 - 8. A wired pipe joint, comprising:
 an elongate tubular shank defining an axial bore and first and second ends;
 electrical coupling means for providing electrical coupling from a location in the
 first end of said shank to a location in the second end of said shank;
 a first flux-loop inductive coupler element located within the first end of said
 - shank and connected to a first end of said electrical coupling means; and a second flux-loop inductive coupler element located within the second end of said shank and connected to a second end of said electrical coupling means;
 - wherein each flux-loop inductive coupler element includes a ring-like core having a high magnetic permeability and a conical-section annular face transverse to the plane of said core, the conical-section annular face having an annular groove dividing the conical-section annular face into a larger-diameter conical-section annular face and a smaller-diameter conical-section annular face; and an electrically conductive coil wound within the annular groove.
 - 9. A wired pipe joint according to claim 8, further comprising a first tubular support member adapted to mount said first inductive coupler element within the first end of the axial bore, and a second tubular support member adapted to

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mount said second inductive coupler element within the second end of the axial bore.

- 10. A wired pipe joint according to claim 8, wherein said ring-like core defines a conduit for passage of at least one electrical cable coupled to said coil.
- 11. A current-loop inductive coupler for a wired pipe joint having an axial bore, the current-loop inductive coupler comprising:
- a first pipe joint end having a first shaped surface encircling the bore, the first pipe joint end having a first layer of high-conductivity, low-permeability material on the first shaped surface defining a first shaped belt;
- a first ring-like core concentric with, fixedly attached to, and partially enclosed by said first shaped belt;
 - a first electrically conductive coil wound about said first ring-like core;
 - a second pipe joint end having a second shaped surface encircling the bore, the second pipe joint end having a second layer of high-conductivity, low-permeability material on the second shaped surface defining a second shaped belt;
 - a second ring-like core concentric with, fixedly attached to, and partially enclosed by said second shaped belt;
 - a second electrically conductive coil wound about said second ring-like core; and electrical coupling means for coupling said first coil to said second coil.
 - 12. A current-loop inductive coupler element, comprising:
 - a first pipe joint end of a first pipe joint defining an axial bore, the first pipe joint end having a first shaped surface encircling the bore, said first shaped surface having a first layer of high-conductivity, low-permeability material thereon to form a first shaped belt;
 - a first ring-like core concentric with, fixedly attached to, and partially enclosed by said first shaped belt; and
 - a first electrically conductive coil wound about said first ring-like core;
- wherein said first shaped belt is shaped to cooperate with a second shaped belt of
 an adjacent second pipe joint end of a second pipe joint, said second shaped
 belt partially enclosing a second electrically conductive coil, such that the two

shaped belts form a closed toroidal electrical conducting path enclosing said first coil and said second coil when said first pipe joint and said second pipe joint are mated.

- 13. A current-loop inductive coupler element according to claim 12, wherein said first ring-like core is made of a material selected from a group of materials, the group consisting of Supermalloy and Metglas.
- 14. A current-loop inductive coupler element according to claim 12, wherein said high-conductivity, low-permeability material is a material selected from a group of materials, the group consisting of copper, brass, bronze, beryllium copper, silver, aluminum, gold, tungsten, and zinc.
- 15. A current-loop inductive coupler element according to claim 12, wherein each ring-like core is mounted proximate to a pipe joint sealing face.
- 16. A wired pipe joint having an axial bore, the wired pipe joint comprising: an elongate tubular shank having a first high-conductivity, low-permeability shaped belt at a shank first end, and a second high-conductivity, low-permeability shaped belt at a shank second end, both shaped belts concentric with the axial bore;
- a first ring-like core, concentric with and partially enclosed by said first shaped belt;
- a first electrically conductive coil wound about said first ring-like core; a second ring-like core, concentric with and partially enclosed by said second shaped belt;
- a second electrically conductive coil wound about said second ring-like core; and electrical coupling means for coupling said first coil to said second coil.
- 17. A wired pipe joint according to claim 16, wherein said first ring-like core is made of a material selected from a group of materials, the group consisting of Supermalloy and Metglas®.
- 18. A wired pipe joint according to claim 16, wherein said first high-conductivity, low-permeability shaped belt includes a material selected from a group of materials, the group consisting of copper, brass, bronze, beryllium copper, silver, aluminum, gold, tungsten, and zinc.

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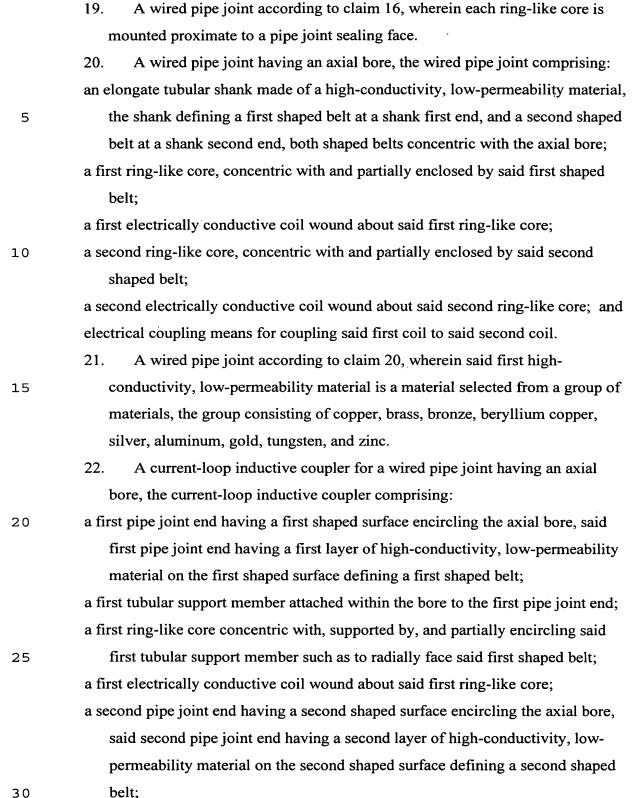
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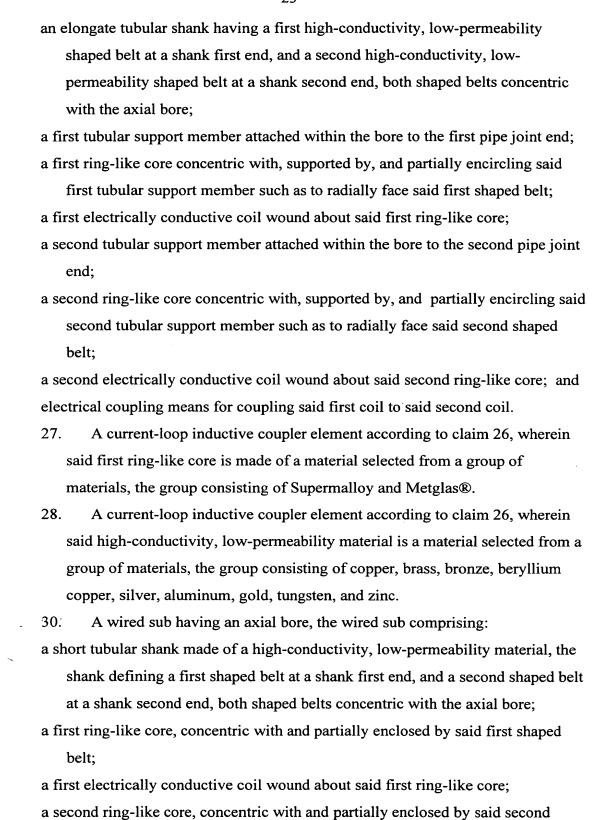
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23.

form a first shaped belt;

- 22 a second tubular support member attached within the bore to the second pipe joint end; a second ring-like core concentric with, supported by, and partially encircling said second tubular support member such as to radially face said second shaped belt; a second electrically conductive coil wound about said second ring-like core;
- and
- electrical coupling means for coupling said first coil to said second coil. A current-loop inductive coupler element, comprising:
- a first pipe joint end of a first pipe joint defining an axial bore, the first pipe joint end having a first shaped surface encircling the bore, said first shaped surface having a first layer of high-conductivity, low-permeability material thereon to
 - a first tubular support member attached within the bore to the first pipe joint end; a first ring-like core concentric with, supported by, and partially encircling said first tubular support member such as to radially face said first shaped belt; a first electrically conductive coil wound about said first ring-like core; wherein said first shaped belt is shaped to cooperate with a second shaped belt of an adjacent second pipe joint end of a second pipe joint, said second shaped belt partially enclosing a second electrically conductive coil, such that the two tubular support members and the two shaped belts form a closed toroidal electrical conducting path enclosing said first coil and said second coil when said first pipe joint and said second pipe joint are mated.
 - 24. A current-loop inductive coupler element according to claim 23, wherein said first ring-like core is made of a material selected from a group of materials, the group consisting of Supermalloy and Metglas®.
 - 25. A current-loop inductive coupler element according to claim 23, wherein said high-conductivity, low-permeability material is a material selected from a group of materials, the group consisting of copper, brass, bronze, beryllium copper, silver, aluminum, gold, tungsten, and zinc.
 - 26. A wired pipe joint having an axial bore, the wired pipe joint comprising:

shaped belt;



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a second electrically conductive coil wound about said second ring-like core; and electrical coupling means for coupling said first coil to said second coil.

- 31. A wired sub according to claim 30, wherein said first high-conductivity, low-permeability material is a material selected from a group of materials, the group consisting of copper, brass, bronze, beryllium copper, silver, aluminum, gold, tungsten, and zinc.
- 32. A wired sub having an axial bore, the wired sub comprising:
 a short tubular shank made of a high-conductivity, low-permeability material, the shank defining a shaped belt at a shank end concentric with the axial bore;
 a ring-like core, concentric with and partially enclosed by said shaped belt; and an electrically conductive coil wound about said first ring-like core.